# Evaluation of the Abundance of Large Striped Bass Predators in the Primary Channel between the Trashrack and Louvers at the Tracy Fish Collection Facility

## Principal Investigators

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## Study Summary

California exports approximately 6.0 million acre ft. of water annually from the Sacramento/San Joaquin River Delta (Delta) to central and southern California for agriculture, municipal, and industrial needs. The water is diverted and transported by two primary pumping facilities: Jones Pumping Plant (JPP) and Harvey O. Banks Delta Pumping Plant. Both sites are equipped with fish salvaging facilities upstream of the pumping plants to reduce the number of fish entrained at the pumps. Both the federal Tracy Fish Collection Facility (TFCF) and state Skinner Delta Fish Protective Facility use a behavioral louver-bypass system to guide fish out of the canal and into collection tanks, where they are held until they are transported back to the Delta. Fish enter both facilities through a trashrack (56-mm-diameter slots) and must swim through a primary and a secondary channel before arriving at the final holding tank. Once at the holding tank fish are removed and placed into a large tanker truck and transported back to the northern Delta.

The facility salvage efficiency can be reduced by large predatory striped bass (*Morone saxatilis*) residing within the facility because they consume the fish passing through the facility and reduce louver efficiency when they chase fish through the louvers. These fish enter the facility two ways. First, the primary channel louver panels are raised daily and this allows the predators from the 4 km of water downstream to enter. Second, predators that are small enough can pass through the trashrack and then maintain their position in the primary channel and feed until they are too big to leave. Estimating the abundance of striped bass that are too big to leave the primary channel is the focus of this project.

Within the facility, striped bass can reside in the holding tanks, secondary channel, and primary channel. Predators can be efficiently removed from the holding tanks and secondary channel but not the primary channel. The negative influence of

these large striped bass (>45 cm FL) residing in the primary channel (between trashrack and louvers) is recognized as a potential problem, yet there is currently no estimate of their abundance. These large fish swim fast enough that they can maintain themselves inside the primary channel indefinitely. From angling data in the primary channel over the last 10 years we know that most of the predators in the primary are large striped bass. Abundance data will be useful in helping to determine the impact predators have on the salvage efficiency. Population estimates should be conducted throughout the year to see how their abundance changes with time. Unfortunately, for most of the year the water velocity in the primary channel is too fast to sample effectively. There are times when the water velocity is slowed down for maintenance or research, and during these times sampling could be completed.

This study has been in progress for several years as only one or two data points are collected each year. In 2009, two days of gillnetting were performed for a depletion fishing test for another Tracy study; however, no Change-in-Ratio test was completed due to a lack of labor and excessive wind. In 2010, the trashrack was removed and the new trashrack cleaner was installed; consequently, no Change-in-Ratio test completed.

## Problem Statement

Fish entrained into the Tracy Fish Collection Facility (TFCF) likely pass by predators at various locations in the system before they reach the holding tank and are released back to the wild. The number of predators can be controlled in the secondary channel and holding tanks; however, they cannot be controlled in the primary channel. Predators can reduce the facility salvage efficiency by eating fish entering the facility and chasing fish downstream through the louvers so that these fish are not salvaged. To determine how big an impact the predatory fish in the primary channel are having on the facility salvage efficiency their abundance must be determined.

## Goals and Hypothesis

*Goals:*

1. Develop a method for selectively capturing striped bass (and no threatened or endangered species) in the primary channel that are too large to swim through the trashrack.

2. Develop a method for estimating the number of large striped bass in the primary channel during low flow periods.

3. Determine the rate at which the large striped bass can re-colonize the primary channel during times of low flow.

4. Determine the species, size, and sex of all predators caught in the large mesh gill nets.

*Hypotheses:*

1. Striped bass will be the most abundant predator caught in large mesh gill nets in the primary channel.

2. The numbers, size, and sex of predatory striped bass caught at the three locations in the primary channel will be equal.

3. Consecutive predator estimations within a month apart will have fewer fish caught in the second sampling.

## Materials and Methods

The number of large striped bass (>45 cm FL) in the primary channel will be estimated with the Change-In-Ratio method (Seber 1982). Abundance estimates for fish smaller than this size will not be attempted as they are free to come and go at will through the trashrack. A known number of tagged striped bass will be introduced into the primary channel during low flow conditions and then immediately gill netted out. The fraction of tagged fish removed determines the efficiency of the gill netting. The number of non-tagged fish and gill net efficiency are used together to calculate how many non-tagged fish are residing in the primary channel during our sampling.

Seber (1982) provides tables for estimating the sample size needed for estimating the population size with less than 25% error with 90% probability. Smaller samples sizes are needed when the tagged release group is large in relation to the target population. For this study we tried to get the tagged release group to be in the range of 60–100% of the size of the target population. Our preliminary guess was there were between 30–50 large striped bass in the primary channel therefore we selected to release 30 tagged fish.

Success of the study will depend on our ability to contain the predators in the primary channel. The primary channel is nearly a closed system for large striped bass (>45 cm FL) when the louvers in the primary channel are not being cleaned. This is because fish of this size cannot swim through either the 25-mm-diameter primary louver or the 56-mm trashrack openings. The only location the predators trapped within the primary channel can travel is into the primary bypasses and these can be closed for short durations while the study is being completed. This method will require that tagged fish be graded to ensure that they cannot fit through the louver arrays (25 mm spacing) and through the trashrack (56 mm spacing). In addition, the four bypass tubes should be closed for the duration of the experiment for best results (4 h; 1 h acclimation/mixing, 3 h fish with gillnets). If the regulatory agencies will not grant the closing of the bypasses for 4 h then the method can be slightly modified, but this will likely make the estimate less precise. If the bypasses are left open, then after the gill netting the number of tagged fish found the holding tanks and secondary channel should be deducted from the number of predators introduced into the primary channel. If too many fish enter the secondary channel, this method will not work.

Thirty striped bass will be caught with fishing rods within the primary channel and held in the Tracy Aquaculture Facility (TAF) in a large 5700-L tank. It may take several months to collect 30 fish for the study and should not severely impact the number of fish in the primary channel if there is fast rate of re-colonization. In addition, these captured fish will be held for several months before being used for the experiment. Measurements (FL, [mm], width [mm], and wet-weight [kg]) will be recorded and all fish will be assigned a unique tag for their release location. Two tags will be given to each fish, a numbered Floy tag inserted under the dorsal fin and a hole punch in the anal fin. The hold punch tag is to determine the rate of tag shedding due to gill netting.

The predator release will take place immediately after the morning primary louver cleaning (0900 h) if there is only 1–3 pumps on at the Jones Pumping Plant. Once cleaning is complete the four bypass tubes will be closed to make the primary channel a closed system. It is important to release the striped bass after the primary louvers are cleaned as they are routinely lifted out of the water for cleaning. The predators will be released into the primary channel behind the trashrack and will be evenly distributed as much as possible. Five release locations were selected that have easy access:

1. North side of trashrack
2. South side of trashrack
3. Bypass number four
4. South wall 1/3 distance from trashrack
5. South wall 2/3 distance from trashrack

The predator estimation process needs to be completed in a short period of time so that the facility salvage process is less impacted. Therefore, only a short 1-h period has been selected to allow the predators a time to acclimate in the primary channel and a 3-h period allowed for gillnetting. After releasing the tagged predators, three 9-kg monofilament gill nets (15-cm stretch mesh, 18 m long, 3.7 m deep) will be used to fish the primary channel. The nets will be fished mid-channel at the front, middle, and end of the primary channel. We will collect as many tagged and wild predators as possible for 3 h. All fish caught will be measured (FL, TL, width, and depth) and sexed. The stomach contents will be identified, and the tags recorded. From previous experience, striped bass removed from gill nets either die immediately or die in captivity due to infections therefore as much information from each fish will be recorded. If the nets become saturated with fish, multiple sets can be completed. If multiple sets are needed a population depletion estimate can be completed in addition to the Change-In-Ratio method (Seber 1982) and the results from the two methods compared. If this second method is utilized, the amount of fishing time per net set will be standardized to 20 minutes (min) per set and four complete sets (three nets each) will be collected. Confidence intervals (95%) will be generated for each population estimate and population calculations will be completed in Excel.

Statistical analyses will be performed using Minitab 15 software package. A descriptive statistics table will be generated for each day giving the numbers and sizes of fish collected, and cumulative percentiles based on FL. A heterogeneity chi-squared statistical analysis will be used to compare the striped bass count data between the three net locations to see if fish catch is related to location (Zar 1999). Data will be pooled from all sample days if there is acceptable homogeneity among trials. Analysis of variance will be used to compare average fish lengths between the three net locations for each trial and all trials combined. The Shapiro-Wilk's test for normality and the Levene's test for homogeneity of variances will be used to determine ANOVA assumptions. The Tukey's test will be used for all pair-wise multiple comparisons for parametric data. Data that do not meet the ANOVA assumptions and are unable to be power or log transformed will be compared with a Kruskal-Wallis non-parametric ANOVA on ranks with the Dunn's test for pairwise multiple comparisons (Zar 1999). Differences will be considered significant at $P<0.05$.

## Coordination and Collaboration

This work will be coordinated with other Tracy researchers and diversion workers at the TFCF. Work will be performed onsite during VAMP (April 15–May 15) and other times when the JPP is at reduced pumping. This project will be slow at generating data as the project is labor intensive as it requires 6 to 8 people to operate and the gill nets cannot be fished while it is windy. Data collection will continue for up to 3 years and a draft report for peer review will be submitted once all 3 years of data are collected.

## Endangered Species Take Issues

This study will not involve handling or capturing endangered or threatened species; however, salmonid "take," as defined by the National Marine Fisheries Service, will occur. Take may happen through increased predation and by reducing salvage efficiency when the bypass tubes are turned off. Salmon could potentially be eaten by the striped bass introduced into the primary channel; however, since they initially came from this location this should not result in additional loss that would not occur normally. A few salmon are expected to be lost due to the bypasses being closed for 4 h. Due to the anticipated loss of salmon and steelhead, a Section 10 permit has been submitted for this work. Delta smelt Section 10 permits are not needed as it is covered under our biological opinion.

## Dissemination of Results

A Tracy Series Report volume will be prepared and published upon completion of the study. Progress updates and presentations will be provided internally upon request by TTAT and other interagency technical forums. Data collection will continue for up to three years and a draft report for peer review will be written once the data is collected.

## Literature Cited

Seber, G.A.F. 1982. *The Estimation of Animal Abundance and Related Parameters,* Second edition. Griffin, London. Chapters 7 and 9.

Zar, J.H. 1999. *Biostatistical Analysis*, Fourth edition. Prentice Hall.